

REMARKS

Claims 1-43, 55 and 56 are pending in the application with claims 1, 18, 26, and 31 amended herein. Applicants express appreciation for the allowance of claims 55 and 56.

Claims 1-15 and 18-30 stand rejected under 35 U.S.C. §102(b) as being anticipated by Aarik. Applicants request reconsideration.

Amended claim 1 sets forth a deposition method that includes, among other features, at a first temperature, contacting a substrate with a surface activation agent and adsorbing a first layer over the substrate. At a second substrate temperature greater than the first temperature, the method includes contacting the first layer with a first precursor gas and also chemisorbing some of the first precursor gas into a second layer at least one monolayer thick over the substrate. Pages 2-3 of the Office Action allege that Aarik discloses every limitation of claim 1. However, Applicants assert that claim 1 fails to disclose contacting the first layer with a first precursor gas at a second temperature greater than the first temperature and also chemisorbing some of the first precursor gas into a second layer.

Page 2-3 of the Office Action allege that page 263 of Aarik discloses the claimed process occurring at a second temperature greater than the first temperature. However, review of page 263 reveals that such text does not disclose contacting the first layer with a first precursor gas and also chemisorbing some of the first precursor gas into a second layer, as set forth in claim 1. Contrary to the Office's allegations, page 263 of Aarik does not disclose contacting the TiCl_4 layer that was deposited at 425°C with H_2O gas at 700°C and also chemisorbing some of the H_2O gas into a second layer at 700°C .

The text relied upon on page 263 of Aarik states "... the data of previous experiments [7, 8] have shown that temperatures as high as 700°C are needed to cause

partial phase transition from TiO_2 -II to rutile in the case of ALD-grown films. Thus, the phase transition of the material grown before reaching the critical thickness, seems not to be probable either." The context of the referenced text is a discussion in Aarik as to why ALD of TiO_2 sometimes produces a TiO_2 -II crystal phase and other times produces a rutile crystal phase. The referenced text rules out the possibility that TiO_2 is deposited by ALD in a TiO_2 -II phase and then transitions during the deposition to a rutile phase. That is, Aarik expressly states "that temperatures as high as 700°C are needed to cause partial phase transition." Accordingly, since the deposition of TiO_2 occurs at 425°C , as stated on page 260 of Aarik, one of ordinary skill would not expect a transition from TiO_2 -II to rutile during deposition. As Aarik expressly states, "the phase transition of the material grown before reaching the critical thickness seems not to be probable either."

Clearly then, Aarik cannot be considered to disclose the claim 1 limitation of contacting the first layer with a first precursor gas at a second temperature greater than the first temperature and also chemisorbing some of the first precursor gas into a second layer.

The temperature of 700°C described in Aarik is not indicated in any way as a possible temperature for contacting Aarik's deposited TiCl_4 with H_2O gas and also chemisorbing some of the H_2O gas into a second layer. At least for such reason, Aarik fails to disclose each and every limitation of amended claim 1.

In addition, Aarik states that "the data of previous experiments [7, 8] have shown that temperatures as high as 700°C are needed to cause partial phase transition." Applicants earlier cited the data of such previous experiments in reference [8] as Aarik et al, "Control of Thin Film Structure by Reactant Pressure in Atomic Layer Deposition of TiO_2 ," Journal of Crystal Growth, Vol. 169, pp. 496-502, 1996 (hereinafter Aarik 1996). The pertinent Aarik 1996 text occurs in column 2 of page 498 to column 1 of page 499.

The discussion in Aarik 1996 involves a test of deposited films to determine temperatures at which a phase transition takes place from a TiO_2 -II crystal structure to a rutile crystal structure. Aarik 1996 states that "an annealing temperature as high as 700°C was necessary in order to observe the appearance of rutile." (Emphasis added.)

Thus, contrary to the Office's position, the "temperatures as high as 700°C " language in the Aarik reference cited by the Office does not in any way involve a deposition process. Instead, the references themselves expressly state that the temperature pertains to annealing of films already formed. As such, neither Aarik nor Aarik 1996 can be considered to disclose the claim 1 contacting of the first layer with a first precursor gas at a second temperature greater than the first temperature and also chemisorbing some of the first precursor gas into a second layer. Merely annealing at 700°C a material previously deposited at 425°C cannot be considered to disclose the claim limitation. At least for such additional reason, Aarik fails to disclose each and every element of claim 1.

At least for the reasons described herein, Aarik does not anticipate claim 1. Applicants further assert that Aarik fails to suggest every limitation of claim 1. Claims 2-15 depend from claim 1 and are not anticipated at least for such reason as well as for the additional limitations of such claims not disclosed.

Amended claim 18 sets forth a deposition method that includes, among other features, at an initial temperature less than a chemisorption temperature of a surface activation agent, adsorbing the agent over a substrate and, at a deposition temperature greater than the initial temperature, atomic layer depositing a first species over the substrate from a precursor gas. Pages 2-3 of the Office Action allege that Aarik discloses atomic layer depositing H_2O at a temperature of 700°C . However, as may be appreciated from the discussion herein regarding the deficiencies of Aarik as applied to claim 1, the

temperature of 700° C described in Aarik cannot be considered to disclose the claimed atomic layer depositing of a first species over the substrate from a precursor gas. According to Aarik, a 700° C temperature would only be applied after ALD of TiO₂ and, accordingly, would not disclose ALD of a first species over a substrate from a precursor gas at 700° C. The 700° C temperature would only be applied to solid layers already deposited. At least for such reason, Aarik does not anticipate claim 18. Claims 19-25 depend from claim 18 and are not anticipated at least for such reason as well as for the additional limitations of such claims not disclosed.

Amended claim 26 sets forth a deposition method that includes, among other features, adsorbing a surface activation agent over a substrate where, during the adsorbing, at least an outer surface of the substrate is at a first temperature less than a chemisorption temperature of the agent. The method includes altering a temperature of at least a portion of the substrate and chemisorbing a monolayer of a first compound over the substrate from a precursor gas and substantially displacing the agent from over the substrate. During the first compound chemisorbing, at least an outer surface of the substrate is at a second temperature greater than the first temperature. The method includes chemisorbing a monolayer of a second compound on the first compound monolayer. As may be appreciated from the discussion herein regarding the deficiencies of Aarik as applied to claims 1 and 18, Aarik fails to disclose every limitation of claim 26. Specifically, Aarik does not disclose any chemisorbing of a first compound from a precursor gas over a substrate with an outer surface being at a second temperature greater than a first temperature at which a surface activation agent was adsorbed over the substrate. Claims 27-30 depend from claim 26 and are not anticipated at least for such reason as well as for the additional limitations of such claims not disclosed.

Based on Applicants' assertions herein, it is evident that claims 1-15 and 18-30 are not anticipated by Aarik. Applicants request allowance of such claims in the next Office Action.

Claims 16 and 17 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Aarik in view of Sherman. Applicants request reconsideration. Claims 16 and 17 depend from claim 1 the subject matter of which is described above. Sherman does not disclose or suggest and is not alleged by the Office to disclose or suggest the deficiencies of Aarik as applied to claim 1. Accordingly, both Aarik and Sherman are deficient in the same respect. Combination of such references cannot be considered to disclose or suggest subject matter that is absent from both. At least for such reason, claims 16 and 17 are patentable over Aarik in view of Sherman.

Claims 31-43 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Aarik in view of Doering. Applicants request reconsideration.

Amended claim 31 sets forth a deposition method that includes, among other features, contacting a bulk semiconductor wafer with a cooling medium to establish an initial temperature, contacting a wafer with a surface activation agent and adsorbing a first layer on the wafer, the initial temperature being less than a chemisorption temperature of the agent, and placing the wafer on a heated wafer chuck and establishing a deposition temperature greater than the initial temperature. The method includes, at the deposition temperature, contacting the first layer with a deposition precursor gas and chemisorbing a second layer over the wafer. Pages 5-6 of the Office Action rely upon Aarik as allegedly disclosing all the limitations of claim 31 except for placing the wafer on a heated wafer chuck. As may be appreciated from the discussion herein regarding the deficiencies of Aarik as applied to claims 1 and 18, Aarik at least does not disclose or suggest the claim

31 limitation of, at a deposition temperature greater than an initial temperature, contacting the first layer with a deposition precursor gas and chemisorbing a second layer. Doering does not disclose or suggest the subject matter absent from Aarik and is not alleged by the Office to remedy such deficiencies. Accordingly, combination of Aarik and Doering cannot be considered to disclose or suggest subject matter that is absent from both. At least for such reason, claim 31 is patentable over Aarik in view of Doering. Claims 32-43 depend from claim 31 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. Applicants request allowance of claims 31-43 in the next Office Action.

Applicant herein establish adequate reasons in support of allowance for claims 1-43 and request allowance of all pending claims 1-43, 55, and 56 in the Office Action.

Respectfully submitted,

Dated: 23 Jun 2003

By: 

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